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XEROX CORPORATION
100 CLINTON AVE., SOUTH, XEROX SQUARE, 20TH FLOOR
ROCHESTER, NY 14644

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CHENG, PETER L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/733,608	BALA, RAJA	
	Examiner	Art Unit	
	Peter L. Cheng	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 December 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-12 and 14-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-12 and 14-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 December 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)✓
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 1, 8, 12, and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by **KASSON [US Patent 5,450,216]**.

As for claims 1 and 12, KASSON teaches a gamut mapping system

["method and system for gamut-mapping color images from device-independent form to device-dependent gamut"; **Abstract, lines 1 - 3]**,

comprising:

an image processing module for transforming an input image into a luminance component L_{in} and chrominance components, C_1 and C_2

[Fig. 7A "extract L" step **58** and "extract C1, C2" step **60;** "the source image is produced at step 56 in the (L, C1, C2) color space and the luminance and chrominance components [are] extracted at steps 58 and 60, respectively"; **col. 11, lines 8 - 11];**

a spatial low pass filter, responsive to L_{in} for outputting a filtered luminance component L_f, *wherein L_f is a function of L_{in}*;

[Fig. 7A "low-pass filter" step **70** *produces a low-pass filtered value **L'_l** from **L_l**; **L'_l** corresponds to **L_f** and **L_l** corresponds to **L_{in}**;*

from equation 1, [$L_D = L_l - (L'_l - L'_{CM}) * W$] (**col. 11, line 35**), L_l corresponds to L_{in} and L'_l corresponds to L_f**]**

and a luminance compression module responsive to L_f and L_{in} for outputting a compressed luminance signal L_{out} that is within an achievable luminance range of an output device

[Fig. 7A "display luminance output" step **80** produces a compressed luminance signal, L_D, according to equation 1 (**col. 11, line 35**); L_D corresponds to L_{out}.

KASSON further cites, "Most pixels that fall outside of the output display gamut ("out-gamut") are mapped into the gamut using a combination of *spatial filtering* and *non-linear compression* embodied as weighted compensation of both luminance and chrominance image components"; **col. 4, lines 32 - 37];**

wherein the luminance compression module combines two compression functions $L_{comp1}(L_{in})$ and $L_{comp2}(L_{in})$ via a blending function $\alpha(L_f)$

[The blending function corresponds to W in equation 1 [$L_D = L_I - (L'_I - L'_{CM}) * W$] (**col. 11, line 35**) which varies the overall proportion of a <u>*first function*</u> L_I with respect to a <u>*second function*</u> ($L'_I - L'_{CM}$) which are both based on the input luminance and together, are used to derive a compressed luminance value]

<u>and wherein $L_{comp1}(L_{in})$, $L_{comp2}(L_{in})$ and $\alpha(L_f)$ are all functions of L_{in}</u>

[As noted above, both *first* and *second* functions are based on the input luminance. **W** corresponds to the blending function which also depends on the input luminance. With regards to step **84** in **Fig. 7B**, KASSON teaches a preferred embodiment where "M_B represents the chroma magnitude value of a point on the gamut boundary 18 having the hue angle (H_I) and luminance (L_I) values of the image pixel being mapped"; **col. 12, lines 4 – 7.** As shown in **Fig. 7B,** the chroma-corrected weight **W** is dependent on the value M_B which in turn depends on input luminance, L_I.

In regards to a different embodiment, KASSON teaches another way to calculate the weight W. With regards to **Fig. 6** step **50**, an "out-of-gamut" distance is computed. With regards to **Fig. 3**, KASSON teaches that a "reasonable method is to select the shortest distance between the input pixel 22 and gamut boundary 18 (shown as point 24). If desired, a constant chroma distance *(requiring only changes in luminance) such as the distance between input pixel 22 and boundary point 26 may be used*"; **col. 10, lines 25 – 30.** Using this method, a

gamut error signal M_E, a function of the difference between the input luminance (L_I) and a gamut-mapped luminance (L_B), is then "low-pass filtered at step 52 to remove high spatial frequency components and then processed in step 54 to clip and scale as necessary to create the weight (W) used by the averaging step 44"; **col. 10, lines 47 – 51].**

Regarding claims 8 and 19, KASSON further teaches, respectively, the system of claim 1, or the method of claim 12,

wherein the luminance compression module, responsive to the chrominance components C_1 and C_2, in addition to L_f and L_{in}, for outputting a compressed luminance signal L_{out} that is within the achievable luminance range of an output device

[KASSON further teaches a method of adjusting the chrominance values so that the resulting display image luminance and chrominance values are within the gamut of the display image device; see **Fig. 7C** "display image (L_D, C_{D1}, C_{D2}) step **106;** "Fig. 7C provides a simple illustration of a preferred embodiment of the chrominance correction step"; **col. 12, lines 33 – 34.** The results are "two display chrominance components (C_{D1}, C_{D2}), which represents the remaining information necessary to construct the final gamut-mapped display image at 106"; **col. 12, lines 40 – 44].**

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 3 - 7, and 14 - 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over **KASSON [US Patent 5,450,216]** in view of **ESCHBACH [US Patent 6,342,951 B1]** and **LEE [US Patent 5,012,333]**.

Regarding claims 3 and 14,

wherein L_{out} is computed according to the relationship

$L_{out} = \alpha(L_f)\, L_{comp1}(L_{in}) + (1 - \alpha(L_f))\, L_{comp2}(L_{in})$.

ESCHBACH teaches the same inverse-gamma-inverse luminance compression function, $\mathbf{L_{comp1}(L_{in})}$, **[**see equations for "new values" of R, G and B; **col. 7, lines 40 - 44].** ESCHBACH further teaches that "the input pixel values IPV can be defined in terms of a luminance value Y and two chrominance values C1, C2 (e.g., CIELAB). In such case, the above-described gamma processing is applied only to the luminance component Y"; **col. 7, lines 64 – 67.** "Thereafter, a step or means S2 performs the ... centroid gamut clipping operation *or other suitable clipping operation* so that any out-of-gamut output pixels values ... are mapped into the output gamut"; **col. 6, lines 9 – 13.**

Per applicant's written description, function $\mathbf{L_{comp2}(L_{in})}$ "softly compresses the low luminance region, and preserves shadow detail in the lightness range 0 – L_{black} ... at the expense of contrast in the dark and midtone regions"; **page 3, paragraph 7, lines 2 – 5.** Applicant further teaches that functions $\mathbf{L_{comp1}(L_{in})}$ and $\mathbf{L_{comp2}(L_{in})}$ "exemplify the *classic trade-off* between preservation of contrast and shadow detail"; **page 3, paragraph 7, lines 5 – 6.**

From the teachings of ESCHBACH and those of the applicant, it would have been obvious to one of ordinary skill in the art at the time the invention was made to process an image by combining functions similar to $\mathbf{L_{comp1}(L_{in})}$ and $\mathbf{L_{comp2}(L_{in})}$ so as to preserve shadow detail in low luminance regions and preserve contrast in the midtone regions.

LEE discloses a method of interactively adjusting the dynamic range for printing digital images. LEE's system enables one to adjust the luminance according to whether the input luminance is within a shadow, midtone or highlight range. The adjustment curve shown in **Fig. 6** is a "piecewise linear curve, usually having three segments"; **col. 10, lines 42 – 44.** The dynamic range adjustment function **[Fig. 3** block **140]** takes, as input, a low-pass filtered luminance signal **[**"The luminance image signals are directed to ... a low pass (Gaussian) filter" which "provides a second output to a dynamic range adjustment curve block 140"; **col. 5, lines 43 - 48]** and produces, according to the piecewise linear curve in Fig. 6, a corrected luminance value.

LEE teaches that the corrected luminance is a function of a low-pass filtered input luminance value, and that correction is typically performed in one of three regions – shadow, midtone or highlight.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of LEE with those of ESCHBACH, KASSON and of the applicant's to combine $\mathbf{L_{comp1}(L_{in})}$ and $\mathbf{L_{comp2}(L_{in})}$ in such a way so that $\mathbf{L_{comp2}(L_{in})}$ is used in the shadow region, $\mathbf{L_{comp1}(L_{in})}$ is used in the highlight region, and a combination of both are used in the midtone region. Weighted averaging is a well-known method of combining functions to smoothly transition from one region (i.e., the shadow region) to another region (i.e., the highlight region).

Regarding claims 4 and 15, wherein

$\alpha(L_f)$ is a piecewise linear function,

determined by two breakpoints, B_1 and B_2.

and claims 7 and 18, wherein

$\alpha(L_f) = 0$ for values of L_f between 0 and B_1;

$\alpha(L_f)$ increases linearly from 0 to 1 for values of L_f from B_1 to B_2;

and $\alpha(L_f) = 1$ for values of L_f between B_2 and L_{max},

where L_{max} is a maximum luminance achievable by the output device.

As noted above, LEE teaches luminance correction in one of three regions – shadow, midtone and highlight, and a dynamic range adjustment curve which contains three piecewise linear sections, and therefore, two breakpoints.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of LEE with those of ESCHBACH, KASSON and of the applicant's to create a piecewise linear weighting function that combines **$L_{comp1}(L_{in})$** and **$L_{comp2}(L_{in})$** in such a way so that **$L_{comp2}(L_{in})$** is used in the shadow region (i.e., **$\alpha(L_f) = 0$ for values of L_f between 0 and B_1**), **$L_{comp1}(L_{in})$** is used in the highlight region (**$\alpha(L_f) = 1$ for values of L_f between B_2 and L_{max}**), and a combination of both are used in the midtone region (i.e., **$\alpha(L_f)$ increases linearly from 0 to 1 for values of L_f from B_1 to B_2**). Weighted averaging is a well-known method of

combining functions to smoothly transition from one region (i.e., the shadow region) to another region (i.e., the highlight region).

Regarding claims 5 and 16,

wherein function L_{comp1} is optimized for preserving overall image contrast.

and claims 6 and 17,

wherein function L_{comp2} is optimized for preserving shadow detail.

As noted above, applicant teaches that functions $\mathbf{L_{comp1}(L_{in})}$ and $\mathbf{L_{comp2}(L_{in})}$ "exemplify the *classic trade-off* between preservation of contrast and shadow detail"; **page 3, paragraph 7, lines 5 – 6.** The existence of such curves is well known in the art.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of LEE with those of ESCHBACH, KASSON and of the applicant's to create a piecewise linear weighting function that combines $\mathbf{L_{comp1}(L_{in})}$ and $\mathbf{L_{comp2}(L_{in})}$ in such a way so that shadow detail is preserved in low luminance areas and overall image contrast is preserved in midtone and highlight areas.

5. Claims 9 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over **KASSON [US Patent 5,450,216]** in view of **GRUZDEV [US Patent 6,868,179 B2]**.

Regarding claims 9 and 20, KASSON *does not specifically teach* the system of claim 1, or the method of claim 12, respectively,

wherein the low pass filter comprises a constant weight filter.

However, GRUZDEV discloses a method of correcting image saturation. GRUZDEV teaches that a color component "may be smoothed by any method well known in the art, for example, a Gaussian filter, and averaging filter or other low-pass filter"; **col. 5, lines 60 – 62.** A simple averaging filter over a specified number of input image pixels can be considered a "constant weight" filter.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have implemented the low-pass filter, as taught by KASSON, with a "constant weight" filter since such a filter is simple to implement.

6. Claims 10 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over **KASSON [US Patent 5,450,216]** in view of **MORONEY [US Patent Application 2002/0186387 A1]**.

Regarding claims 10 and 21, KASSON *does not specifically teach* the system of claim 1, or the method of claim 12, respectively,

wherein the image is down-sampled prior to filtering and upsampled and interpolated after filtering.

However, MORONEY teaches a method of correcting colors of an input image by "locally modifying the input pixel values according to pixel neighborhoods" **[Abstract].** MORONEY discloses a method for generating a "tone mask through a low-pass filtering operation"; **page 2, paragraph 23, lines 1 – 2.** MORONEY, like KASSON and in the instant application, filters the luminance component of the color image. "The process initially converts (at 205) the received color image to a monochrome image (i.e., an image that only contains black and white pixels, or contains black, white, and gray values)"; **page 2, paragraph 23, lines 3 – 6.** After "inverting the monochrome image" **[page 2, paragraph 24, lines 1 - 2],** the process "decimates (at 215) the inverted monochrome image. Some embodiments decimate this image by selecting every nth (e.g., 20th) horizontal and vertical pixel in this image ..., and discarding the remaining pixels"; **page 2, paragraph 24, lines 6 – 11.** This "decimation" is equivalent to "down-sampling" the image.

Next, the process filters the image by performing "(at 220) a smoothing operation on each pixel in the decimated, inverted, monochrome image"; **page 2, paragraph 25, lines 1 – 3.**

After filtering, the process "upsamples and interpolates" by scaling "(at 225) the smoothed, decimated, inverted, monochrome image back up to the resolution of the original received image"; **page 2, paragraph 26, lines 1 – 3.**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of MORONEY with those of KASSON to down-sample the image data prior to filtering and up-sampling/interpolating after filtering so as to reduce the computational time and load on the system.

7. Claims 11 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over **KASSON [US Patent 5,450,216]** in view of **ESCHBACH [US Patent 6,342,951 B1]**.

Regarding claims 11 and 22, KASSON *does not specifically teach* the system of claim 1, or the method of claim 12, respectively, further comprising

> **a color correction module for transforming L_{out}, C_1 and C_2 to CMYK for printing.**

KASSON does teach that "many different display devices and printing devices can be devised for color imaging, each represented by a different display gamut boundary" **[col. 6, lines 27 – 30]** and that an ink-jet printer may use cyan, magenta, yellow and black ink colors; **col. 6, lines 15 – 17.**

ESCHBACH teaches a method for mapping out-of-gamut colors into an output gamut, such as a printer gamut. **Fig. 5** illustrates the production of "gamut clipped color" data for a "CMYK" printer and the transformation of that data to CMYK for printing (see "printer transformation" step **S3**). Although Fig. 5 illustrates the invention in RGB color space, ESCHBACH teaches "that it is equally applicable to any other color space" **[col. 5, lines 63 - 66]** as in a luminance-chrominance CIELAB color space shown in Figs. 3 and 4; **col. 5, lines 23 - 26].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of ESCHBACH with those of KASSON to transform the resulting luminance and chrominance values to a printer color space such as CMYK when the desired target output device is a printer.

Response to Arguments

8. Applicant's arguments filed 12/14/2007 have been fully considered but they are not persuasive.

With respect to applicant's arguments that

1. *Applicant's method blends two compression functions – whereas, Kasson's functions are not compression functions.*

2. *The two functions blended in Applicant's method depend only on input image luminance, whereas one of the two terms Kasson is blending depends on both input luminance and chrominance.*

3. *Applicant's blending weight $W(\alpha(L_f))$ is derived based on only the input image luminance. Kasson's weight is derived from an error signal between input and gamut-mapped images, which requires knowledge of input luminance and chrominance.*

have been considered.

In reply:

Regarding point #1, Kasson's two functions, $\mathbf{L_I}$ and $\mathbf{(L'_I - L'_{CM})}$, respectively correspond to an "identity function" and a scaled difference between a low-pass filtered version of the input luminance and a "chroma-maximized" luminance. Although Kasson's functions admittedly differ from the Applicant's luminance compression functions, $\mathbf{L_{comp1}(L_{in})}$ and $\mathbf{L_{comp2}(L_{in})}$ (as seen from **Figs. 1** and **2**), since current claims 1 and 12 merely mention the existence of two "luminance compression functions" which

are functions of $\mathbf{L_{in}}$ without providing any details on how they are derived (e.g., their dependence on an output device's "reproducible lightness range" or that they have, in part, the shape of an "inverse-gamma-inverse" curve, and for low luminance, one "hard-clips" while the other "soft compresses"), the former ($\mathbf{L_I}$) could be interpreted as a type of "compression function" which is "uncompressed", whereas, the latter function ($\mathbf{L'_I - L'_{CM}}$) moves the input luminance toward a "chroma-maximized" luminance which is contained within or on the surface of an *output device's* color gamut.

Regarding points #2 and #3, Examiner concurs with Applicant that Kasson's "blending depends on *both input luminance and chrominance*", and Kasson's "weight is derived from an error signal ... which requires knowledge of *input luminance and chrominance*." However, claims 1 and 12 currently cite luminance compression functions and a blending function that are functions of input luminance *instead of* only functions of input luminance, L_{in}. Clearly, KASSON's blended functions and weight are also functions of input luminance, L_{in}.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter L. Cheng whose telephone number is 571-270-3007. The examiner can normally be reached on MONDAY - FRIDAY, 8:30 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, King Y. Poon can be reached on 571-272-7440. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

KING Y. POON
SUPERVISORY PATENT EXAMINER

plc
February 25, 2008